Economic Growth, Property Valuation Change, and Transportation Investments

DAVID SWENSON, LIESL EATHINGTON, AND DANIEL OTTO

Transportation related infrastructure investment is closely linked to economic performance of a region. In assessing the role of transportation investment in economic growth, it is important to refine the spatial detail of analysis and to use effective data analysis techniques. As an alternative to county level data, property tax data that is collected annually can be used to evaluate economic growth patterns at a detailed level. Because of overlapping jurisdictions 1,500 separate parcels can be identified within the study region. This paper uses GIS techniques to examine patterns of economic change in a nine-county central Iowa region between 1987 and 1995 and to relate these changes to investments in transportation infrastructure during the same time period. Specifically, the economic change will include property valuation change for residential, commercial, industrial and agricultural classes of property. A mapping of valuation changes in this region depicts the major shifts in capital wealth. Overall, a growing metro core city is ringed by high growth urbanized clusters at the fringe. Nonurbanized cities located within 20 miles of the metro core also grew strongly. Residential values declined in the core city while growing dramatically in the suburban fringes. Commercial values grew strongly in the metro core and even more so in the western suburbs. Transportation infrastructure investments are shown to coincide with areas rapid population and valuation growth. Key words: GIS, property valuation, transportation, spatial.

INTRODUCTION

Transportation related infrastructure investment is closely linked to economic performance of a region. Planners and economic development professionals debate whether these transportation investments occur in response to growth pressures or whether the investments lead or stimulate new economic growth. As local economies change and grow, additional land is typically required for housing and for commercial purposes. As a result, property values increase and a conversion of land to higher valued uses occurs. The change in demand for land and properties becomes capitalized into property values and becomes a reliable indicator of regional economic performance. Transportation investments can also affect these values by providing greater access for commuters and commercial activities.

This report demonstrates a measure of economic change within a metropolitan region and its extended labor and trade market area involving disaggregation at levels finer than the traditional county level reporting that is common of most U.S. and state secondary data sources. This disaggregation helps us to better understand some of the spatial dynamics of economic growth and decline in a Midwestern metropolitan region and compare these dynamics to modern urban development concepts. Instead of relying on the annual counts of employment and income (or population) in a county, our data set is comprised of net growth in capital values within specific taxing districts or fractions of taxing districts as they are enumerated.

When studying economic change, aggregation at the county level can be relatively sufficient for most purposes. Elemental mapping programs can be used to track and display gross changes and patterns of change over time. While useful, the county level of analysis (or subcounty level every ten years) does not allow us to get some of the more intriguing intra-regional transformations that may be occurring as a result of central place dynamics, structural changes in an area's economy, or major infrastructure investments. Comparisons of different patterns of growth for a large sample of central places are another method of isolating the potential range of responses to change and the spatial distribution of those responses *(1)*. These, too, are limited to census year comparisons.

The proper documentation of economic or social change at subcounty levels and the accounting of the change using GIS techniques and standard urban hierarchy designations can lead to meaningful analytic outcomes. There are over 8,200 unique taxing districts in Iowa for which property data are collected annually. These districts include cities, counties, townships, school districts, community colleges, and special purpose districts. Some boundaries coincide, others do not. Almost all of the cities and all of the townships are contained within the confines of county boundaries. School districts, community college districts, and special districts do not coincide with county or township boundaries. It is because of these overlaps in boundaries that we get 8,200 jurisdictional fragments out of the state's 1,500 local units of government.

Figure 1 displays a nine-county region of central Iowa, the locus of our study. Within the counties we can see the township boundaries and the municipal boundaries (gray-shaded). The large cluster in the center is the Des Moines MSA. This level of analysis gives us a lot of spatial detail provided we know information at the place (city) level or the township level (remainder of county subdivision). In all, there are 263 distinct spatial/governmental units measurable within the region. We have also overlaid the school district boundaries that serve the region. Each intersection or intrusion produces jurisdictional chunks of space that are geographically identifiable. These parcels are irregularly shaped and now number 744. These parcels are relatively standard over time and change only when school districts consolidate or municipalities annex unincorporated territory.

Department of Economics, Iowa State University, 560 Heady Hall, Ames, Iowa 50011.

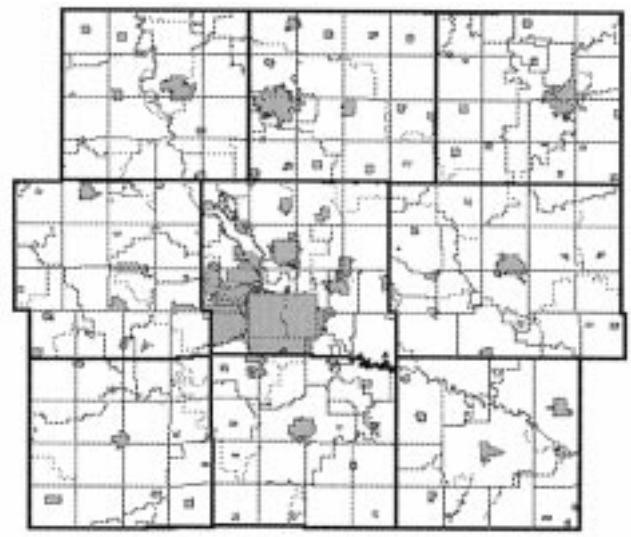

FIGURE 1 Study area: school districts, municipalities, townships and counties.

These data were originally compiled for three purposes: the first was to demonstrate the potential of analyzing economic information at levels that were more refined than the typical county-level analysis (Salge, J. *unpublished data*). The second original purpose of the data was for the purpose of isolating relative changes in area property tax capacities as they relate to taxable property value changes *(2).* Another reason for compiling the data this finely was for the purpose of testing whether a jurisdictional model of capital valuation change can be linked to infrastructure levels and social characteristics within the jurisdictions measured (Swenson, D. and L. Eathington. *unpublished data).* In particular, we were looking for a reasonable alternative to hedonic price approaches to measuring the likely demand for and relationship of infrastructure investment to capitalized regional growth.

REGIONAL CHANGE AND THE URBAN HIERARCHY

The nine-county region that we study contains a core metropolitan county (Polk County – Des Moines City) along with two adjacent metropolitan counties that comprise the entire Polk County MSA. The remaining counties that are adjacent to Polk County are urban counties whose populations range from 13,000 to 75,000. The region is roughly in the center of the state, and Polk County/Des Moines is the intersection of two interstate highways. Economic growth in the region has been strong over the past decade. Since 1984, nonfarm employment has grown by 50,000 jobs. Overall, net job growth in the state has accrued disproportionately to the state's eight MSAs and six other regional trade centers. The state's remaining 85 counties have experienced only minor levels of job growth and economic expansion. The unevenness of growth is such that nearly a half of the state's non-metropolitan counties continued to lose population since 1990 while all of the metropolitan and metro-adjacent counties have grown. Recognizing that job growth in these areas nearly always outstrips population growth rates, we are left with the conclusion that greater and greater numbers of these jobs appear to be filled by incommuters from surrounding counties.

In all, we can arrive at a set of relatively safe conclusions about the nature and character of economic growth in Iowa when we compare our counties by level of urbanization and adjacency to metropolitan areas as would be the case if we used USDA ERS rural typology measures (often called "Beale" or rural-urban continuum codes). The growth is, of course, limited to county summaries and tells us nothing about the nature and character of change at levels finer than the county level.

For our purposes, the dynamics of change within the counties in the nine-county region are more interesting and, perhaps, much more telling. Although GIS helps us to identify the patterns of change, it is also instructive to reliably classify the jurisdictions under study in order to look for meaningful average experiences. Here we have a relatively large metropolitan core city that is surrounded by several adjacent urbanized cities. Just outside of the urbanized core are the remaining cities within the three counties that comprise the MSA. Lying outside of the metro county cities but still within the metro counties are the unincorporated areas represented as townships or township remainders that either are adjacent to the metro core city or are not. Farther out we have the remaining cities in the counties adjacent to the metro counties and the unincorporated remaining space in those counties. Accordingly, we have an urban hierarchy beginning at the urban core and moving outward by level of incorporation, physical adjacency to the core metro city, and presence within the metropolitan counties.

We next calculated net shifts in property values in each of the parcels comparing 1987 with 1993. Shifts for each class of property in each jurisdictional fragment were calculated using shift-share methods. The actual competitive share or change in value for any jurisdiction in the state is for each class of property is:

Competitive Property Share =
Property Value in 1987 *
(Jurisdictional Percentage Change – Statewide Percentage Change)

Though this approach is usually used for employment change over time, it works well for other measures of economic activity in a jurisdiction *(2,3).* The shift-share or net of shares method allows us to net out the statewide growth characteristics of each property class to identify the potential shifts in capital values geographically in the state. We are, in effect, measuring the relative changes or position each jurisdiction finds itself regarding valuation change over the time periods. When we use this method, the sum of all changes for all jurisdictions statewide equals zero. All net growth is the amount in excess of the expected value (the state rate of growth). Those that did not grow at the state rate lost ground to other places. Using this method within a coherent economic region allows us to calculate the net capital flows or competitive positions among regions and to isolate, in our case, changes within our region.

Table 1 is a compilation of the shifts in property values on a per square mile basis. Using per square mile allows us to standardize the change; we get an intuitively more clear idea of the rate of wealth generated in the measured areas. The rate of residential capital wealth growth per square mile was over twice as great as the per square mile losses in the metro core. The very same pattern emerged in the non-urbanized communities: their per square mile gains were nearly twice as great as the per square mile losses suffered in the unincorporated adjacent areas.

TABLE 1 Net Shifts in Property Values Per Square Mile by Urbanization Level, 1987-1993

	Residential	Commercial	Industrial	Total
Metro Core	(5,245,470)	1,919,086	(168,391)	2,540,723
Urbanized Adjacent	11,208,754	5,926,829	(454,175)	26,015,628
Urban Non-Adjacent	3,427,962	1,591,499	(194,021)	6,780,076
Non-Urbanized Adjacent	(1,846,823)	(901,116)	(490,022)	(2,181,692)
Non-Urbanized Non-Adjacent	118,450	(5,618)	2,067	61,058
Other Urban (nonmetro)	(22,358)	(339,234)	218,804	3,657,134
Other Non-Urban (nonmetro)	16,717	(3,927)	(2,014)	(78,187)
9 County Total	74,077	71,313	(16,408)	351,400

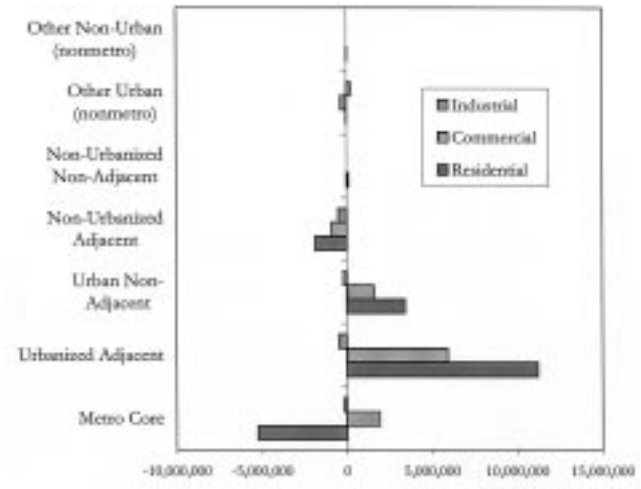

FIGURE 2 Shift in capital values per square mile, 1987 to 1993.

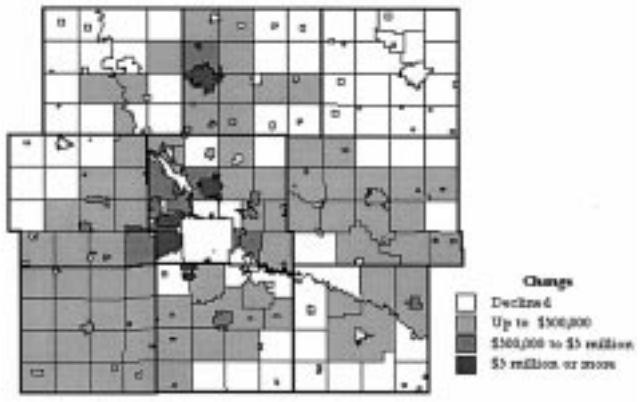

FIGURE 3 Net shift in residential values per square mile, 1987-1993.

Strong commercial property value per square mile gains are also evident and demonstrate that, on a per square mile basis, commercial growth in the urbanized adjacent cities was over three times greater than in the metro core and more than three and a half times greater than in the urban non-adjacent metro cities. It is interesting to note that the $.9 million in commercial decline per square mile in the non-urbanized adjacent territories continues the relative losses that those properties posted, especially when compared to neighboring incorporated places. Industrial losses per square mile indicate that the average gain per square mile in the nonmetro urban areas are meaningful in that their gains are in excess of the metro core or the urban non-adjacent declines. Their gains per square mile, however, are at a rate much lower than the rate of erosion posted by the urbanized adjacent and non-urbanized adjacent parcels in the region.

On a total valuation basis, the rate of growth in the urbanized adjacent communities was over ten times greater than in the metro core and almost four times greater than in the urban nonadjacent communities. The differences reflect not only the total dollar amount invested but also greater investment densities in the suburban fringe.

Figure 2 displays the weighted net shifts per square mile of territory in the jurisdictional parcels for residential, commercial, and industrial properties. These properties most adequately represent the net demand and valuation of housing along with changes and concentrations of business and industrial activity.

Ideas of central place assume capital concentration in these growth centers. We also know that there are both centralization and decentralization forces at work, especially in cities of some size. Suburban flight is a direct response to the disamenities and diseconomies of urbanization. Commercial concentrations, on the other hand, continue to accrue to growth centers, and significant portions of urban vitality are centered in service, retail, and wholesale trade expansions. For much of the Midwest in recent years there has been an increase in manufacturing employment, especially relative to the nation's overall decline in manufacturing jobs *(4)*. These jobs have located in areas usually outside of metropolitan places. If we move from the graph (Figure 2) back to Table 2 we note that total property shares (per square mile) were significantly greater in the non-metro cities than in the metro core. Whether this is an indication of stability at the fringe or just the overwhelming influence of a handful of central places at the fringe remains to be seen.

DISPERSION OF PROPERTY SHIFTS

Figures 3 through 6 depict the major shifts in capital wealth in the region on a per square mile basis. In Figure 3 we see that residential declines were evident in the core metro city and in the northwest, northeast, and southeast corners of the region. Residential growth in the southwestern portion is attributable to the area's rolling hills and river valleys giving rise to the development of pricey country estates. Otherwise, communities with the greatest growth rate are either urbanized communities or the remaining non-adjacent communities and townships within the three metro counties. Six of these areas posted housing valuation growth in excess of $5 million per square mile. This same high level of growth is also

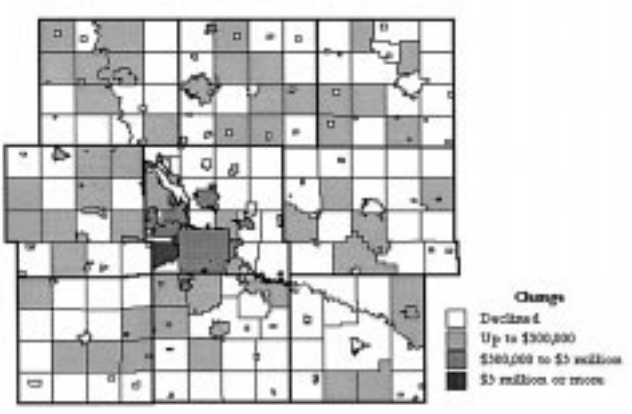

FIGURE 4 Net shift in commercial values per square mile, 1987-1993.

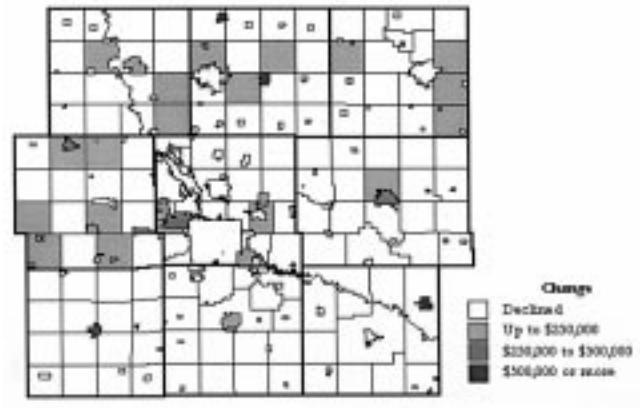

FIGURE 5 Net shift in industrial values per square mile, 1987-1993.

noted in a nonmetro community (Ames) north of the metro, which also serves as a significant central place in its own right. Strong growth is also evident in many of its surrounding townships, especially those bordering major highways. Despite their growth, the modal experience of nonmetro cities was a slight decline. These declines are most notable as distance from the metro core increases and as size of the community declines.

Figure 4 demonstrates the pattern of commercial valuation change in the region. Here we see definite concentrations of growth within the metro core, and even more so in the city's western suburbs. We also see that where residential growth was generally widespread, the growth in commercial values is more associated with population densities and at list fringe access to the metro core. The vast majority of nonmetro county cities posted erosions in commercial wealth with the exception of the two large cities in the counties to the north and northwest of the metro. Growth exceeded $5 million in commercial value per square mile in one western suburb, and from $.5 million to $5 million in the remaining metro urbanized and most of the nonurbanized communities.

Figure 5 shows the powerful decentralizing forces at work in manufacturing sectors. Rotations outward from the metro core are evident with minor growth in urbanized cities and outlying communities, and even stronger rates of growth in many very small and quite distant communities. Some of this growth is also evident in the township remainders as small firms opt to locate outside of small communities where possible. (It is important to note that the scale of change is different in this figure.)

In Figure 6 we see the distribution of gross valuation changes. After sorting out the losses attributable to farmland value erosions along with widespread declines in the value of utility properties (telecommunications and railroads, primarily), we can ascertain the regions of strong growth. A growing metro core city is ringed by high growth urbanized centers. Nonurbanized cities located within 20 miles of the metro core also grew strongly. Much lower incidences of growth are evident in the remaining incorporated and unincorporated territories. Except for the central communities in the northeast and the southeast counties, the only outlying growth activity (including the two other metropolitan counties) is in their larger city/county seat.

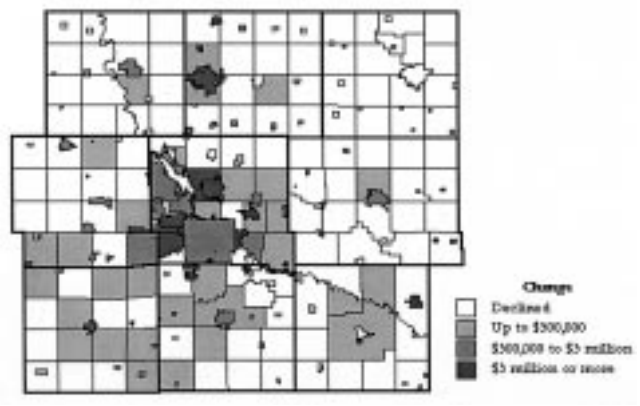

FIGURE 6 Net shift in gross values per square mile, 1987-1993.

CORRELATES WITH TRANSPORTATION INVESTMENT

One of the expected uses of this data set was to identify the spatial coincidence of transportation with residential and commercial growth with an eye toward developing simulation models that would help to predict expected property growth given roadway growth. With the use of TIGER/File data on roads in Iowa we were able to isolate all of the road segments within our study region and calculate their lengths for 1987 and 1993 by our jurisdictional units of analysis. Knowing the lengths also allowed us to calculate additions in roads, as measured by lengths, and changes in the number of interchange segments, as measured by access nodes to limited access highways. We excluded gravel and dirt roadways as unimproved roads that would in the main be negatively correlated with improved roads.

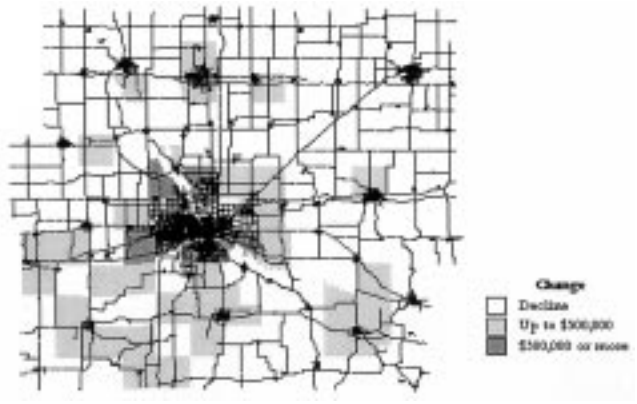

FIGURE 7 Transportation infrastructure and gross valuation shifts per square mile, 1987-1993.

For each jurisdiction, we were able to construct measures of total roadway length, changes in length, density of roadway development, along with the number and change in the number of interchanges. We could then be able to compare these infrastructure measures to the amount of final residential and commercial property values along with the changes in values measured by net shifts per square mile.

Figure 7 displays the improved roadway grid for our region of study. This roadway has been laid over a map of the change in gross values per square mile. One notices, of course, the overall density and concentration of roads and interchanges in the metro core. These overall densities are fairly indicative of the region's population densities. There is, of course, strong correlation between population and population density with total roads and roadway densities along with total property values and growth per square mile in values.

CONCLUSIONS

Our analysis confirmed several patterns of change indicative of usual central place dynamics and others that warrant additional research. There is a definite erosion of core city residential worth in clear favor of fringe, urbanized are investment. Commercial growth is strong and total capital shifts accruing to the metro core, however, are very small in relationship to those accruing to the adjacent urbanized fringe. Outlying communities within the metro counties and beyond are also posting gains, but we must carefully scrutinize the extent to which those gains are part of regional growth dynamics or local factors. Infrastructure investments are shown to be coincident with areas of rapid economic growth. More detailed information is needed to address the issues of timing of impacts from these infrastructure investments.

Future research also needs to collect more detail on other capital investments made by state and local government and to refine the property valuation system to the parcel level based on market transactions. Other applications could examine valuation patterns to other applications such as telecommunications investments.

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